SCHIFF HARDIN LLP
6600 Sears Tower, Chicago, Illinois 60606-6473
Telephone: (312) 258-5500 Facsimile: (312) 258-5600 www.schiffhardin.com

FACSIMILE TRANSMITTAL SHEET

CLIENT/MATTER NO.: 23000-1700

DATE & TIME: Thursday, May 21, 2009 03:27:30 PM

TO THE FOLLOWING:

NAME: Examiner Michael Band

COMPANY: U.S. Patent Office

FACSIMILE NO.: 15712739815 COMPANY NO.: U.S. Patent Office

FROM: Trevor B. Joike DIRECT DIAL NO.: 312.258.4970

Including cover sheet, total number of pages = 14

If there are any problems with this transmission, please call 312.258.4970.

COMMENTS:

Examiner Band,

Please see the attached amendments that I would like to discuss with you regarding U.S. application 10/550,506.

Thank you.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Yizhou Song et al.	)
Serial No.: 10/550,506	)
For: **THIN FILM FORMING METHOD AND FORMING DEVICE THEREFOR**	)
Filed: September 23, 2005	)
Group Art Unit: 1795	)
Examiner: Michael A. Band	)
Confirmation No.: 9959	

RESPONSE TO 03/04/09 OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Dear Sir:

INTRODUCTION

Claims 9, 10, and 15-28 are now in the application. Claims 1-8 and 11-14 are canceled. Claims 9 and 10 are withdrawn from consideration. Claims 15-28 are new.

IN THE CLAIM

1-8. (canceled)

9. (withdrawn) A thin film forming apparatus comprising:

a substrate holder which is disposed in a vacuum tank and which holds a substrate;

a film formation process zone which is disposed in the vacuum tank and in which sputtering is performed with respect to a target comprising at least one type of metal to form an intermediate thin film on the substrate;

a reaction process zone comprising an active seed generator for generating an active seed of a reactive gas, and disposed in the vacuum tank, in which the intermediate thin film is reacted with the active seed of the reactive gas to form a thin film;

a partitioning mechanism for spatially separating the film formation process zone and the reaction process zone from each other;

a substrate holder driver for driving the substrate holder in order to convey the substrate between a position facing the film formation process zone and a position facing the reaction process zone; and

substrate holder conveying speed controller for controlling the substrate holder driver in a range configured to form the thin film having an optical characteristic value in a region where a hysteresis phenomenon occurs in which a change route of the optical characteristic value differs with respect to a reactive gas flow rate in a case where the flow rate of the reactive gas is increased and in a case where the rate is decreased.

10. (currently amended and withdrawn) The thin film forming apparatus according to claim 9 4, wherein the region where the hysteresis phenomenon occurs is a region of the optical characteristic value of the thin film formed when the reactive gas introduced in performing the sputtering has a flow rate of 15 sccm or less, which does not include 0 sccm.

11-14. (canceled)

15. (new) A method of forming a thin film comprising:

sputtering a target in a sputtering zone, wherein the target comprises at least one type of metal, wherein the sputtering forms an intermediate thin film on a substrate,

and wherein the intermediate thin film comprises the metal or an incomplete reactant of the metal;

reacting the intermediate thin film with a reactive gas in a reactive zone so as to convert the intermediate thin film into a compound of the metal;

repeatedly conveying the substrate between the sputtering zone and the reactive zone; and,

varying the speed of the conveying so as control an optical characteristic of the thin film in a hysteresis region which would have otherwise occurred if the optical characteristic had been controlled by controlling a rate of flow of the reactive gas, wherein the hysteresis region is a region where the optical characteristic is different depending upon whether the flow rate of the reactive gas is increased or is decreased.

16. (new) The method of claim 15, wherein the reacting of the intermediate thin film with a reactive gas in a reactive zone comprises reacting the intermediate thin film with the reactive gas and an inactive gas in the reactive zone, and wherein the inactive gas has a chemically inactive property.

17. (new) The method of claim 15, wherein the hysteresis region comprises a region where the reactive gas has a flow rate of 15 sccm or less and does not include 0 sccm.

18. (new) The method of claim 15, wherein the varying of the speed of the conveying comprises:

rotating a substrate holder holding the substrate on an outer peripheral face, where the substrate holder has a cylindrical or hollow polygonal columnar shape; and,

varying a rotation speed of the substrate holder so as control the optical characteristic of the thin film in the hysteresis region.

19. (new) The method of claim 15, wherein the repeated conveying of the substrate comprises conveying the substrate along a periphery having at least one of a cylindrical and a hollow polygonal columnar shape.

20. (new) The method of claim 15, wherein the sputtering of a target in a sputtering zone comprises reversing polarity between first and second sputtering electrodes so that the first electrode oscillates between cathode and anode states, so that the second electrode has an

anode state while the first electrode has a cathode state, and so that the second electrode has a cathode state while the first electrode has an anode state.

21. (new) The method of claim 15, further comprising supplying the reactive gas to the reactive zone at a constant flow rate in the hysteresis region of the optical characteristic.

22. (new) An apparatus for forming a thin film, the apparatus comprising:

a sputtering zone holding a target, wherein the target comprises at least one type of metal, wherein the target is sputtered to form an intermediate thin film on a substrate, and wherein the intermediate thin film comprises the metal or an incomplete reactant of the metal;

a reactive zone having a reactive gas that reacts with the intermediate thin film so as to convert the intermediate thin film into a compound of the metal; and,

a conveyor that repeatedly conveys the substrate between the sputtering zone and the reactive zone, wherein the speed of the conveyor is varied so as control an optical characteristic of the thin film in a hysteresis region which would have otherwise occurred if the optical characteristic

had been controlled by controlling a rate of flow of the reactive gas, and wherein the hysteresis region is a region where the optical characteristic is different depending upon whether the flow rate of the reactive gas is increased or is decreased.

23. (new) The apparatus of claim 22, wherein the reactive zone also includes an inactive gas, and wherein the inactive gas has a chemically inactive property.

24. (new) The apparatus of claim 22, wherein the hysteresis region comprises a region where the reactive gas has a flow rate of 15 sccm or less and does not include 0 sccm.

25. (new) The apparatus of claim 22, wherein the conveyor comprises a rotating conveyor and a substrate holder, wherein the substrate holder holds the substrate, wherein the rotating conveyor rotates the substrate holder holding the substrate on an outer peripheral face, and wherein the substrate holder has a cylindrical or hollow polygonal columnar shape.

26. (new) The apparatus of claim 22, wherein the conveyor is arranged to convey the substrate along a periphery having at least one of a cylindrical and a hollow polygonal columnar shape.

27. (new) The apparatus of claim 22, wherein the sputtering zone includes first and second electrodes, wherein during sputtering a polarity of the first electrode oscillates between cathode and anode states so that the second electrode has an anode state while the first electrode has a cathode state, and so that the second electrode has a cathode state while the first electrode has an anode state.

28. (new) The apparatus of claim 22, wherein the reactive gas is supplied to the reactive zone at a constant flow rate in the hysteresis region of the optical characteristic.

REMARKS

In the Office Action, the Examiner rejected claim 14 under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. Old claim 14 is similar to new claims 20 and 27.

Claims 20 and 27 are described in paragraphs 0061 and 0062 of the substitute specification. Paragraph 0061 discloses that, with one polarity of an alternating current source, the target 29a (i.e., the first electrode 21a) forms a cathode and the target 29b (i.e., the second electrode 21b) necessarily forms an anode. Similarly, paragraph 0062 discloses that, when the polarity of the alternating current source changes, the target 29b (i.e., the second electrode 21b) forms the cathode, and the target 29a (i.e., the first electrode 21a) forms the anode.

As can be seen, the present claims comply with the written description requirement of 35 U.S.C. §112, first paragraph.

In the Office Action, the Examiner rejected the claims under 35 U.S.C. §103(a) as being unpatentable over Hartsough in view of Sproul.

Applicants are concerned that the Examiner may believe that the previous claims recited increasing or

decreasing the reactive gas flow rate in order to control the optical characteristic. However, that is not the case.

The present claims make it clear that the reference to increasing or decreasing the reactive gas flow rate is merely to define the hysteresis region. This hysteresis region is the region where the optical characteristic that would have been obtained if the reactive gas flow rate were increased is different that the optical characteristic that would have been obtained if the reactive gas flow rate were decreased. Accordingly, if the reactive gas flow rate were increased and decreased within the range of flow rates that give rise to the hysteresis effect, the hysteresis effect would make it very difficult to achieve a desired optical characteristic.

To avoid this hysteresis effect, the invention of independent claim 15 is directed to varying the conveying speed while the reactive gas flow rate is in this hysteresis region so as achieve the desired optical characteristic that cannot be easily achieved if the reactive gas flow rate were varied instead of the conveying speed.

(In spite of the discussion above, independent claim 15 does not recite either varying the reactive gas flow rate or controlling the reactive gas at a constant flow rate. Thus, independent claim 15 can be read on a system that

varies both the conveying speed and the reactive gas flow rate as well as on a system that varies the conveying speed but not the reactive gas flow rate.)

Hartsough describes a system in which both the conveying speed and the reactive gas flow rate are set to constant values so as to grow aluminum oxide at a predictable rate. Hartsough does not disclose varying the speed of conveying so as control an optical characteristic of a thin film in a hysteresis region. Indeed, Hartsough discloses neither varying the speed of conveying nor an optical characteristic hysteresis region.

Similarly, Sproul does not disclose varying the speed of conveying so as control an optical characteristic of a thin film in a hysteresis region. Indeed, Sproul discloses neither varying the speed of conveying nor an optical characteristic hysteresis region.

Accordingly, Hartsough and Sproul would not have led the person of ordinary skill in the art to the invention of independent claim 15.

Therefore, independent claim 15 is not unpatentable over Hartsough in view of Sproul.

Because independent claim 15 is not unpatentable over Hartsough in view of Sproul, dependent claims 16-21

likewise are not unpatentable over Hartsough in view of Sproul.

For similar reasons, independent claim 22 is not unpatentable over Hartsough in view of Sproul.

Because independent claim 22 is not unpatentable over Hartsough in view of Sproul, dependent claims 23-28 likewise are not unpatentable over Hartsough in view of Sproul.

CONCLUSION

In view of the above, the claims of the present application patentably distinguish over the art applied by the Examiner. Accordingly, allowance of these claims and issuance of the present application are respectfully requested.

Respectfully submitted,

SCHIFF HARDIN LLP
6600 Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6402
(312) 258-5774
CUSTOMER NO. 26574

By: _____
Trevor B. Joike
Reg. No: 25,542

May 21, 2009